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(54) Title: CHEWING GUM CONTAINING D-TAGATOSE

(57) Abstract

Chewing gums containing D-tagatose and methods of making such gums are disclosed. In one embodiment, the gum comprises about 5 % to about 95 % gum base, about 0.1 % to about 10 % flavoring agent and D-tagatose, the D-tagatose being part or all of the bulk sweetener in the gum. The D-tagatose provides the gum with unique properties, and the gum is non-cariogenic. In other embodiments, the D-tagatose is co-dried with other sweeteners or co-evaporated with a plasticizing syrup to produce unique sweetening ingredients and syrups for gum. The D-tagatose may also be provided in the form of a rolling compound on the gum, or used to form a hard coating for a coated pellet gum.

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CHEWING GUM CONTAINING D-TAGATOSE

BACKGROUND OF THE INVENTION

The present invention relates to improved compositions of chewing gum. More particularly, the invention relates to improving chewing gum by the use of specific bulking agents in sugar and non-sugar chewing gum products to give improved texture, moisture absorption properties, and improved shelf life properties. The improved chewing gum compositions may also be used in a variety of chewing gum products such as confectionery coated chewing gum products.

In recent years, efforts have been devoted to replace sugar and sugar syrups normally found in chewing gum with other carbohydrates and non-carbohydrates. Non-sugar or sugar-free chewing gum, which is growing in popularity, uses sugar alcohols or polyols to replace sugar and sugar syrups. The most popular polyols are sorbitol, mannitol and xylitol. New polyols are being developed using new technology to replace these polyols. New polyols have various unique properties which can improve the taste, texture and shelf life properties of chewing gum for consumers.

The non-sugar polyols have the advantage of not contributing to dental caries of consumers, as well as being able to be consumed by diabetics. However, all polyols have the disadvantage of causing gastro-intestinal disturbances if consumed in too great of a quantity. Therefore it would be a great advantage to

be able to use a carbohydrate or carbohydrate-like food ingredient for chewing gum that would act as a bulking agent, but not contribute to dental caries nor cause gastro-intestinal disturbances.

One such bulking agent is called D-tagatose. This bulking agent, or bulk sweetener, is not approved for use in food products or in chewing gum in the U.S. or in any country. Although a sugar, D-tagatose does not contribute to dental caries, nor does it cause significant gastro-intestinal disturbances and is low in calories. Thus, this ingredient's use in chewing gum could be a definite improvement.

The manufacture of D-tagatose is disclosed in U.S. Patent No. 5,078,796. The use of D-tagatose as a low-calorie carbohydrate sweetener and bulking agent is disclosed in U.S. Patent No. 4,786,722. The use of D-tagatose as an anti-hyperglycemic agent is disclosed in U.S. Patent No. 5,356,879.

SUMMARY OF THE INVENTION

The present invention is a method of producing chewing gum with a new bulk sweetener, specifically D-tagatose, as well as the chewing gum so produced. The bulk sweetener may be added to sucrose-type gum formulations, replacing a small or large quantity of sucrose. The formulation may be a low- or high- moisture formulation containing low or high amounts of moisture-containing syrup. The bulk sweetener, D-tagatose, may also be used in low- or non-sugar gum formulations replacing sorbitol, mannitol, other polyols, or carbohydrates. Non-sugar formulations may include low- or high-moisture, sugar-free chewing gums.

The bulk sweetener, D-tagatose, may be combined with other bulk sweeteners for use in chewing gum, including but not limited to sucrose, dextrose,

fructose, maltose, maltodextrin, xylose, as well as sugar alcohols including but not limited to sorbitol, mannitol, xylitol, maltitol, lactitol, palatinit and hydrogenated starch hydrolyzates such as Lycasin. The bulk sweetener, D-tagatose, may be combined in the gum formulation or co-dried or blended with the other bulk sweeteners prior to use in the gum formulation. Co-drying may be done by various methods of spray drying, fluid bed coating, coacervation, and other granulating or agglomerating techniques. The bulk sweetener, D-tagatose, may also be combined with high potency sweeteners including, but not limited to, thaumatin, aspartame, acesulfame K, sodium saccharin, glycyrrhizin, alitame, cyclamate, stevioside and dihydrochalcones.

This sweetener, D-tagatose, when used as a bulking agent, gives chewing gum an improved texture, an improved shelf life and unique flavor/ sweetness quality. Even though D-tagatose is very similar to sucrose, it is not cariogenic, nor does it cause significant gastro-intestinal disturbances, giving a highly consumer-acceptable chewing gum product.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

D-tagatose is a carbohydrate bulking agent that is similar to fructose. D-tagatose is an isomer of fructose obtained by isomerization of D-galactose, and its sweetness intensity is about 92% of that of sucrose.

D-tagatose is being produced by Biospherics, Inc. and is being marketed under the SUGAREE trademark by MD Food Ingredients. D-tagatose, which is a monosaccharide, is available as an anhydrous crystalline material. In a variety of cariogenicity tests, pure D-tagatose has been found to be non-cariogenic. D-tagatose, like sucrose, has a high melting point of

134°C. D-tagatose can be dissolved in water to make a D-tagatose syrup. Any of these forms of D-tagatose may be used in chewing gum, and the terms D-tagatose and D-tagatose solid/syrup herein refers to all forms.

D-tagatose may be added to chewing gum in its crystalline/solid form or may be dissolved in water. Its solubility in water is about 60% at room temperature, but increases with increased temperature to over 80% at 70°C. D-tagatose may be used in chewing gum as a texture and flavor modifier, bulking agent, and may improve texture, flavor, and shelf life properties. D-tagatose may replace solids like sucrose, dextrose or lactose when used in its powder form, or may replace syrups when used in its liquid or syrup form. At levels of about 0.5% to about 25%, D-tagatose may replace part of the solids in sugar gum or, as a liquid, all or part of the syrup in sugar gum. At higher levels of about 25% to about 90% of the gum formulation, D-tagatose may replace all of the solids in a chewing gum formulation. A preferred range of D-tagatose is about 5% to about 50%, and more preferably about 10% to about 40%, of the gum composition.

Unique chewing gum formulations can be obtained when all bulk sweeteners are replaced with D-tagatose powder and syrup. The slightly lower sweetness intensity allows for use of unique flavor combinations. High intensity sweeteners may be added to increase sweetness to obtain a sweetness more typical of chewing gum formulations. Chewing gum formulations with D-tagatose may contain a very low amount of moisture in the gum formulation, i.e., below about 2%, or may contain a medium amount of moisture, about 2-5%, and may even be a soft gum formulation containing 5% moisture or more.

Although D-tagatose is similar to sucrose, its unique anti-caries properties suggest it may be

used in chewing gum formulations containing non-sugar ingredients. Non-sugar ingredients are alditols such as sorbitol, mannitol, xylitol, lactitol, palatinit (Isomalt), maltitol and hydrogenated starch hydrolyzates. These alditols are used in a variety of combinations to develop unique sugarless chewing gum formulations. D-tagatose may be used to replace the individual alditols or combinations of alditols. With partial replacement of one or more alditols, D-tagatose can be used at levels of about 0.5-25%. If D-tagatose replaces a large amount or most of the alditols, this level may be about 25% to about 90% of the gum formulation.

Some sugar-free chewing gum formulations contain high levels of glycerin and are very low in moisture, i.e., less than about 2%. D-tagatose solids or syrup may replace part or all of the glycerin used in these types of formulations. At higher moisture levels (more than 2%) in sugar-free gum, a liquid sorbitol (70% sorbitol, 30% water) is used. D-tagatose solids or D-tagatose syrup may replace part or all of the sorbitol liquid. New sugar-free syrups like hydrogenated starch hydrolyzates, such as Lycasin, may also be replaced in part or totally by D-tagatose solids or syrup. The same product advantages found with hydrogenated starch hydrolyzates syrups, such as improved product shelf life, improved texture and improved aspartame stability, may also be found with the use of D-tagatose solids or syrup.

Recent advances use hydrogenated starch hydrolyzates (HSH) and glycerin preblended and co-evaporated to reduce moisture in some sugar-free gum formulations. D-tagatose solids and/or syrup may be used to replace part or all of the HSH/glycerin blends in chewing gum formulations. Aqueous D-tagatose solids and/or D-tagatose syrup may also replace HSH in the

preblend with glycerin and be co-evaporated with glycerin to obtain a low moisture, non-crystallizable blend. Combinations of D-tagatose solids/syrup with alditols like sorbitol, maltitol, xylitol, lactitol and mannitol in aqueous form may also be blended with glycerin and co-evaporated for use in low-moisture, sugar-free gum.

In a similar manner, D-tagatose solids/syrup preblended in glycerin and co-evaporated may be used in conventional sugar chewing gum formulations. D-tagatose may be combined with other sugars like dextrose, sucrose, lactose, maltose, invert sugar, fructose and corn syrup solids to form a liquid mix to be blended with glycerin and co-evaporated. D-tagatose solids/syrup may also be mixed with syrup and blended with glycerin and co-evaporated for use in a sugar chewing gum formulation.

D-tagatose bulk sweetener may also be co-dried with a variety of sugars such as sucrose, dextrose, lactose, fructose and corn syrup solids and used in a sugar-containing gum formulation. D-tagatose may be co-dried with a variety of alditols such as sorbitol, mannitol, xylitol, maltitol, palatinit and hydrogenated starch hydrolyzates and used in a sugar-free gum formulation. Co-drying refers to methods of co-crystallization and co-precipitation of D-tagatose with other sugars and alditols, as well as co-drying by encapsulation, agglomeration and absorption with other sugars and alditols.

Co-drying by encapsulation, agglomeration and absorption can also include the use of encapsulating and agglomerating agents. D-tagatose may be mixed with other sugars or alditols prior to being codried by encapsulation or agglomeration, or may be used alone with the encapsulating and agglomerating agents. These agents modify the physical properties of the bulk

sweetener and control its release from chewing gum. Since D-tagatose is highly soluble in water as noted earlier, controlling the release of D-tagatose modifies the texture and flavor of the chewing gum.

Physical modifications of the sweetener by encapsulation with another substrate will slow its release in chewing gum by reducing the solubility or dissolution rate. Any standard technique which gives partial or full encapsulation of the bulk sweetener can be used. These techniques include, but are not limited to, spray drying, spray chilling, fluid-bed coating and coacervation. These encapsulation techniques that give partial encapsulation or full encapsulation can be used individually or in any combination in a single step process or multiple step process. Generally, delayed release of bulk sweetener is obtained in multistep processes like spray drying the bulk sweetener and then fluid-bed coating the resultant powder.

The encapsulation techniques here described are standard coating techniques and generally give varying degrees of coating from partial to full coating, depending on the coating composition used in the process. Also, the coating compositions may be susceptible to water permeation to various degrees. Generally, compositions that have high organic solubility, good film-forming properties and low water solubility give better delayed release of the bulk sweetener. Such compositions include acrylic polymers and copolymers, carboxyvinyl polymer, polyamides, polystyrene, polyvinyl acetate, polyvinyl acetate phthalate, polyvinyl-pyrrolidone, and waxes. Although all of these materials are possible for encapsulation of the bulk sweetener, only food-grade material should be considered. Two standard food-grade coating materials that are good film formers but not water soluble are shellac and Zein. Others which are more

water soluble, but good film formers, are materials like agar, alginates, a wide range of cellulose derivatives like ethyl cellulose, methyl cellulose, sodium hydroxymethyl cellulose, and hydroxypropylmethyl cellulose, dextrin, gelatin, and modified starches. These ingredients, which are generally approved for food use, also give a delayed release when used as an encapsulant. Other encapsulants like acacia or maltodextrin can also encapsulate D-tagatose but may increase the release rate of the bulk sweetener.

The amount of coating or encapsulating material on the bulk sweetener also controls the length of time for its release from chewing gum. Generally, the higher the level of coating the slower the release of the bulk sweetener during mastication. The release rate is generally not instantaneous, but gradual over an extended period of time.

Another method of giving a delayed release of the bulk sweetener is agglomeration of the bulk sweetener with an agglomerating agent which partially coats the bulk sweetener. This method includes the step of mixing the bulk sweetener and agglomerating agent with a small amount of water or solvent. The mixture is prepared in such a way as to have individual wet particles in contact with each other so that a partial coating can be applied. After the water or solvent is removed, the mixture is ground and used as a powdered, coated bulk sweetener.

Materials that can be used as the agglomerating agent are the same as those used in encapsulation mentioned previously. However, since the coating is only a partial encapsulation and the bulk sweetener is very water soluble, some agglomerating agents are more effective in delaying the sweetener release than others. Some of the better agglomerating agents are the organic polymers like acrylic polymers and co-

polymers, polyvinyl acetate, polyvinylpyrrolidone, waxes, shellac, and Zein. Other agglomerating agents are not as effective in giving the bulk sweetener a delayed release as are the polymers, waxes, shellac and Zein, but can be used to give some delayed release. These other agglomerating agents include, but are not limited to, agar, alginates, a wide range of cellulose derivatives like ethyl cellulose, methyl cellulose, sodium hydroxymethyl cellulose, hydroxypropylmethyl cellulose, dextrin, gelatin, modified starches, vegetable gums like guar gum, locust bean gum, and carrageenin. Even though the agglomerated bulk sweetener is only partially coated, when the quantity of coating is increased compared to the quantity of the bulk sweetener, the release of the bulk sweetener can be delayed for a longer time during mastication.

The bulk sweetener may be coated in a two-step process or multiple step process. The bulk sweetener may be encapsulated with any of the materials as described previously and then the encapsulated sweetener can be agglomerated as described previously to obtain an encapsulated/agglomerated/bulk sweetener product that could be used in chewing gum to give a delayed release of bulk sweetener.

In another embodiment of this invention, D-tagatose sweetener may be absorbed onto another component which is porous and become entrapped in the matrix of the porous component. Common materials used for absorbing the bulk sweetener include, but are not limited to, silicas, silicates, pharmasorb clay, spongelike beads or microbeads, amorphous sugars like spray-dried dextrose, sucrose, alditols, amorphous carbonates and hydroxides, including aluminum and calcium lakes, vegetable gums and other spray dried materials.

Depending on the type of absorbent material and how it is prepared, the amount of bulk sweetener that can be loaded onto the absorbent will vary. Generally materials like polymers, spongelike beads or microbeads, amorphous sugars and alditols and amorphous carbonates and hydroxides absorb about 10% to about 40% of the weight of the absorbent. Other materials like silica and pharmasorb clays may be able to absorb about 20% to about 80% of the weight of the absorbent.

The general procedure for absorbing the bulk sweetener onto the absorbent is as follows. An absorbent like fumed silica powder can be mixed in a powder blender and an aqueous solution of the bulk sweetener can be sprayed onto the powder as mixing continues. The aqueous solution can be about 5% to 30% solids, and higher solid levels may be used if temperatures up to 90°C are used. Generally water is the solvent, but other solvents like alcohol could also be used if approved for use in food. As the powder mixes, the liquid is sprayed onto the powder. Spraying is stopped before the mix becomes damp. The still free-flowing powder is removed from the mixer and dried to remove the water or other solvent, and ground to a specific particle size.

After the bulk sweetener is absorbed onto an absorbent or fixed onto an absorbent, the fixative/sweetener can be coated by encapsulation. Either full or partial encapsulation may be used, depending on the coating composition used in the process. Full encapsulation may be obtained by coating with a polymer as in spray drying, spray chilling, fluid-bed coating, coacervation, or any other standard technique. A partial encapsulation or coating can be obtained by agglomeration of the fixative/sweetener mixture using any of the materials discussed above.

The three methods of use to obtain a delayed release of bulk sweetener are: (1) encapsulation by spray drying, fluid-bed coating, spray chilling and coacervation to give full or partial encapsulation, (2) agglomeration to give partial encapsulation and (3) fixation or entrapment/absorption which also gives partial encapsulation. These three methods, combined in any usable manner which physically isolates the bulk sweetener, reduces its dissolvability or slows down the release of bulk sweetener, are included in this invention.

Other methods of treating the D-tagatose bulk sweetener to physically isolate the sweetener from other chewing gum ingredients may also have some effect on its release rate and its effect on chewing gum flavor and texture. The bulk sweetener may be added to the liquid inside a liquid center gum product. The center fill of a gum product may comprise one or more carbohydrate syrups, glycerin, thickeners, flavors, acidulants, colors, sugars and sugar alcohols in conventional amounts. The ingredients are combined in a conventional manner. The bulk sweetener is dissolved in the center-fill liquid and the amount of bulk sweetener added to the center-fill liquid may be about 0.1% to about 20% by weight of the entire chewing gum formula. This method of using the bulk sweetener in chewing gum can allow for a lower usage level of the bulk sweetener, can give the bulk sweetener a smooth release rate, and can reduce or eliminate any possible reaction of the bulk sweetener with gum base, flavor components or other components, yielding improved shelf stability.

Another method of isolating the D-tagatose bulk sweetener from other chewing gum ingredients is to add D-tagatose to the dusting compound of a chewing gum. A rolling or dusting compound is applied to the

surface of chewing gum as it is formed. This rolling or dusting compound serves to reduce sticking to machinery as it is formed, reduces sticking of the product to machinery as it is wrapped, and sticking to its wrapper after it is wrapped and being stored. The rolling compound comprises D-tagatose bulk sweetener alone or in combination with mannitol, sorbitol, sucrose, starch, calcium carbonate, talc, other orally acceptable substances or a combination thereof. The rolling compound constitutes from about 0.25% to about 10.0%, but preferably about 1% to about 3% of weight of the chewing gum composition. The amount of D-tagatose sweetener added to the rolling compound is about 0.5% to 100% of the rolling compound or about 0.005% to about 5% of the chewing gum composition. This method of using D-tagatose bulk sweetener in the chewing gum can allow a lower usage level of the bulk sweetener, can give the bulk sweetener a more controlled release rate, and can reduce or eliminate any possible reaction of the bulk sweetener with gum base, flavor components, or other components, yielding improved shelf stability.

Another method of isolating D-tagatose sweetener is to use it in the coating/panning of a pellet chewing gum. Pellet or ball gum is prepared as conventional chewing gum, but formed into pellets that are pillow shaped or into balls. The pellets/balls can be then sugar coated or panned by conventional panning techniques to make a unique sugar-coated pellet gum. The bulk sweetener is very stable and highly water soluble, and can be easily added to a sugar solution prepared for sugar panning. D-tagatose may be combined with sucrose or used alone in solution as the coating on pellet gum. D-tagatose can also be added as a powder blended with other powders often used in some types of conventional panning procedures. Using D-tagatose sweetener isolates the sweetener from other gum

ingredients and modifies its release rate in chewing gum. Levels of use of D-tagatose may be about 1% to about 100% in the coating and about 0.5% to about 50% of the weight of the chewing gum product. The weight of the coating may be about 20% to about 50% of the weight of the finished gum product.

Conventional panning procedures generally coat with sucrose, but recent advances in panning have allowed the use of other carbohydrate materials to be used in the place of sucrose. Some of these components include, but are not limited to, dextrose, maltose, xylitol, lactitol, palatinit and other new alditols or a combination thereof. These materials may be blended with panning modifiers including, but not limited to, gum arabic, maltodextrins, corn syrup, gelatin, cellulose type materials like carboxymethyl cellulose, or hydroxymethyl cellulose, starch and modified starches, vegetable gums like alginates, locust bean gum, guar gum, and gum tragacanth, insoluble carbonates like calcium carbonate or magnesium carbonate and talc. Antitack agents may also be added as panning modifiers which allow the use of a variety of carbohydrates and sugar alcohols to be used in the development of new panned or coated gum products. Flavors may also be added with the D-tagatose coating and with the D-tagatose bulk sweetener to yield unique product characteristics.

The previously described encapsulated, agglomerated, or absorbed D-tagatose bulk sweetener may readily be incorporated into a chewing gum composition. The remainder of the chewing gum ingredients are non-critical to the present invention. That is, the coated particles of bulk sweetener can be incorporated into conventional chewing gum formulations in a conventional manner. The D-tagatose bulk sweeteners may be used in a sugar-free or sugar chewing gum to modify the sweet-

ness thereof. The coated bulk sweetener may be used in either regular chewing gum or bubble gum.

In general, a chewing gum composition typically comprises a water-soluble bulk portion, a water-insoluble chewable gum base portion and typically water-insoluble flavoring agents. The water-soluble portion dissipates with a portion of the flavoring agent over a period of time during chewing. The gum base portion is retained in the mouth throughout the chew.

The insoluble gum base generally comprises elastomers, resins, fats and oils, waxes, softeners and inorganic fillers. Elastomers may include polyisobutylene, isobutylene-isoprene copolymer and styrene butadiene rubber, as well as natural latexes such as chicle. Resins include polyvinylacetate and terpene resins. Fats and oils may also be included in the gum base, including tallow, hydrogenated and partially hydrogenated vegetable oils, and cocoa butter. Commonly employed waxes include paraffin, microcrystalline and natural waxes such as beeswax and carnauba. According to the preferred embodiment of the present invention, the insoluble gum base constitutes between about 5 to about 95% by weight of the gum. More preferably the insoluble gum base comprises between 10 and 50% by weight of the gum and most preferably about 20 to about 35% by weight of the gum.

The gum base typically also includes a filler component. The filler component may be calcium carbonate, magnesium carbonate, talc, dicalcium phosphate or the like. The filler may constitute between about 5 and about 60% by weight of the gum base. Preferably, the filler comprises about 5 to about 50% by weight of the gum base.

Gum bases typically also contain softeners, including glycerol monostearate and glycerol tri-

acetate. Further, gum bases may also contain optional ingredients such as antioxidants, colors and emulsifiers. The present invention contemplates employing any commercially acceptable gum base.

The water-soluble portion of the chewing gum may further comprise softeners, sweeteners, flavoring agents and combinations thereof. As used herein, the term "bulking and sweetening agents" generically includes sugars, sugar alcohols and syrups thereof. Softeners are added to the chewing gum in order to optimize the chewability and mouth feel of the gum. Softeners, also known in the art as plasticizers or plasticizing agents, generally constitute between about 0.5 to about 15.0% by weight of the chewing gum. Softeners contemplated by the present invention include glycerin, lecithin and combinations thereof. Further, aqueous sweetener solutions such as those containing sorbitol, hydrogenated starch hydrolysates, corn syrup and combinations thereof may be used as softeners and binding agents in gum.

As mentioned above, the D-tagatose solids/syrup bulk sweetener of the present invention will most likely be used in sugar gum formulations. However, sugar-free formulations are also within the scope of the invention. Sugar sweeteners generally include saccharide-containing components commonly known in the chewing gum art which comprise, but are not limited to, sucrose, dextrose, maltose, dextrin, dried invert sugar, fructose, levulose, galactose, corn syrup solids and the like, alone or in any combination.

The D-tagatose solids/syrup bulk sweetener of the present invention can also be used in combination with other sugarless sweeteners. Generally sugarless sweeteners include components with sweetening characteristics but which are devoid of the commonly known sugars and comprise, but are not limited to, sugar

alcohols such as sorbitol, mannitol, xylitol, hydrogenated starch hydrolysates, maltitol and the like, alone or in any combination.

Depending on the particular sweetness release profile and shelf-stability needed, the D-tagatose solid/syrup bulk sweeteners of the present invention can also be used in combination with coated or uncoated high-potency sweeteners or with high-potency sweeteners coated with other materials and by other techniques.

A flavoring agent may be present in the chewing gum in an amount within the range of from about 0.1 to about 10.0 weight percent and preferably from about 0.5 to about 3.0 weight percent of the gum. The flavoring agents may comprise essential oils, synthetic flavors, or mixture thereof including, but not limited to, oils derived from plants and fruits such as citrus oils, fruit essences, peppermint oil, spearmint oil, clove oil, oil of wintergreen, anise, and the like. Artificial flavoring components are also contemplated for use in gums of the present invention. Those skilled in the art will recognize that natural and artificial flavoring agents may be combined in any sensorally acceptable blend. All such flavors and flavor blends are contemplated by the present invention.

Optional ingredients such as colors, emulsifiers and pharmaceutical agents may be added to the chewing gum.

In general, chewing gum is manufactured by sequentially adding the various chewing gum ingredients to a commercially available mixer known in the art. After the ingredients have been thoroughly mixed, the gum mass is discharged from the mixer and shaped into the desired form such as by rolling into sheets and cutting into sticks, extruding into chunks or casting into pellets.

Generally, the ingredients are mixed by first melting the gum base and adding it to the running mixer. The base may also be melted in the mixer itself. Color or emulsifiers may also be added at this time. A softener such as glycerin may also be added at this time, along with syrup and a portion of the bulking agent/sweetener. Further portions of the bulking agent/sweetener may then be added to the mixer. A flavoring agent is typically added with the final portion of the bulking agent. A high-intensity sweetener is preferably added after the final portion of bulking agent and flavor have been added.

The entire mixing procedure typically takes from five to fifteen minutes, but longer mixing times may sometimes be required. Those skilled in the art will recognize that many variations of the above described procedure may be followed.

Examples

The following examples of the invention and comparative examples are provided by way of explanation and illustration.

The formulas listed in Table 1 comprise various sugar-type formulas in which D-tagatose can be added to gum after it is dissolved in water and mixed with various aqueous solvents.

TABLE 1

(WEIGHT PERCENT)

	EX. 1	EX. 2	EX. 3	EX. 4	EX. 5	EX. 6	EX. 7	EX. 8
SUGAR	55.6	56.6	55.6	47.0	53.0	53.0	55.6	47.0
BASE	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
CORN SYRUP	12.9	1.9	8.9	2.9	6.9	6.9	0.0	2.9
PEPPER-MINT FLAVOR	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
GLY-CERIN	1.4	1.4	1.4	0.0	0.0	0.0	1.4	0.0
LIQUID/ D-TAGA-TOSE BLEND	10.0	20.0	14.0	30.0	20.0	20.0	22.9	30.0

EXAMPLE 1

D-tagatose powder can be added directly to the gum.

EXAMPLE 2

An 80 gram portion of D-tagatose can be dissolved in 120 grams of water at 40°C making a 40% solution and added to gum.

EXAMPLE 3

D-tagatose syrup at 70% solids can be added directly to the gum.

EXAMPLE 4

A blend of 80 grams of D-tagatose and 120 grams of water is mixed at 40°C. To this is added 100 grams of glycerin to give a mixture of 27% D-tagatose, 40% water, and 33% glycerin, and added to gum.

EXAMPLE 5

To 140 grams of D-tagatose syrup at 70% solids is added 60 grams of glycerin to give a 70% D-tagatose syrup with 30% glycerin, and added to gum.

EXAMPLE 6

To 140 grams of D-tagatose syrup of 70% solids is added 60 grams of propylene glycol giving a 70% D-tagatose syrup with 30% glycerin and added to gum.

EXAMPLE 7

To 140 grams of D-tagatose syrup at 70% solids is added 89 grams of corn syrup and blended giving a mixture of 61% D-tagatose syrup and 39% corn syrup.

EXAMPLE 8

To a 200 gram quantity of corn syrup is added 100 grams of glycerin. To this mixture is added 75 grams of D-tagatose and blended at 50°C. This mixture is added to gum.

In the next examples of sugar gum formulations, D-tagatose can be dissolved in water and emulsifiers can be added to the aqueous solution. Example solutions can be prepared by dissolving 15 grams of D-tagatose in 70 grams water and in examples 10-14, adding 15 grams of emulsifiers of various hydrophilic-lipophilic balance (HLB) values to the solution. The mixtures can then be used in the following formulas.

TABLE 2
(WEIGHT PERCENT)

	EX. 9	EX. 10	EX. 11	EX. 12	EX. 13	EX. 14
SUGAR	50.7	50.7	50.7	50.7	50.7	50.7
BASE	19.2	19.2	19.2	19.2	19.2	19.2
CORN SYRUP	12.9	12.9	12.9	12.9	12.9	12.9
GLY-CERIN	1.4	1.4	1.4	1.4	1.4	1.4
DEX-TROSE MONOHY-DRATE	9.9	9.9	9.9	9.9	9.9	9.9
PEPP. FLAVOR	0.9	0.9	0.9	0.9	0.9	0.9
BULK SWEET-ENER/ EMUL-SIFIER/ WATER MIXTURE	5.0	5.0	5.0	5.0	5.0	5.0
	None	HLB=2	HLB=4	HLB=6	HLB=9	HLB=12

EXAMPLES 15-20

The same as the formulations made in Examples 9-14, respectively, except that the flavor can be mixed together with the aqueous bulk sweetener solution and emulsified before adding the mixture to the gum batch.

D-tagatose bulk sweetener can also be blended into various base ingredients. A typical base formula is as follows:

	WEIGHT PERCENT
Polyvinyl acetate	27
Synthetic rubber	13
Paraffin Wax	13
Fat	3
Glycerol Monostearate	5
Terpene Resin	27
Calcium Carbonate Filler	12
	100%

The individual base components can be softened prior to their addition in the base manufacturing process. To the presoftened base component, D-tagatose can be added and mixed, and then the presoftened base/bulk sweetener blend can be added to make the finished base. In the following examples, D-tagatose can be mixed first with one of the base ingredients, and the mixed ingredient can then be used in making a base. The ingredients blended with D-tagatose can then be used at the levels indicated in the typical base formula above.

EXAMPLE 21

The terpene resin used to make the base is 80% polyterpene resin and 20% D-tagatose.

EXAMPLE 22

The polyvinyl acetate used to make the base is 80% low M.W. polyvinyl acetate and 20% D-tagatose.

D-tagatose may also be added to an otherwise complete gum base.

EXAMPLE 23

5% D-tagatose can be mixed with 95% of a gum base having the above listed typical formula. The D-tagatose can be added near the end of the process, after all the other ingredients are added.

The samples of finished base made with D-tagatose added to different base components can then be evaluated in a sugar-type chewing gum formulated as follows:

TABLE 3

(WEIGHT PERCENT)

(For Examples 21, 22, and 23)

Sugar	55.2
Base	19.2
Corn Syrup	13.4
Glycerine	1.4
Dextrose Monohydrate	9.9
Peppermint Flavor	0.9
	100%

The theoretical level of D-tagatose bulk sweetener is 1% in the finished gum.

The following Tables 4 through 11 are examples of gum formulations that demonstrate formula variations in which D-tagatose or D-tagatose syrup may be used.

Examples 24-28 in Table 4 demonstrates the use of D-tagatose in low-moisture sugar formulations showing less than 2% theoretical moisture:

TABLE 4
(WEIGHT PERCENT)

	EX. 24	EX. 25	EX. 26	EX. 27	EX. 28
SUGAR	57.9	53.9	48.9	25.0	0.0
GUM BASE	19.2	19.2	19.2	19.2	19.2
CORN SYRUP*	6.0	6.0	6.0	6.0	6.0
DEXTROSE MONOHY-DRATE	10.0	10.0	10.0	10.0	10.0
LACTOSE	0.0	0.0	0.0	5.0	5.0
GLYCERIN*	5.0	5.0	5.0	8.9	8.9
FLAVOR	0.9	0.9	0.9	0.9	0.9
D-TAGATOSE	1.0	5.0	10.0	25.0	50.0

*Corn Syrup is evaporated to 85% solids, 15% moisture

*Glycerin and syrup may be blended and co-evaporated

Examples 29-33 in Table 5 demonstrate the use of D-tagatose in medium-moisture sugar formulations having about 2% to about 5% moisture.

Examples 34-38 in Table 6 demonstrate the use of D-tagatose in high-moisture sugar formulations having more than about 5% moisture.

TABLE 5
(WEIGHT PERCENT)

	EX. 29	EX. 30	EX. 31	EX. 32	EX. 33
SUGAR	52.5	48.5	43.5	25.0	0.0
GUM BASE	19.2	19.2	19.2	19.2	19.2
CORN SYRUP*	15.0	15.0	15.0	18.5	18.5
DEXTROSE MONOHY-DRATE	10.0	10.0	10.0	10.0	10.0
GLYCERIN*	1.4	1.4	1.4	1.4	1.4
FLAVOR	0.9	0.9	0.9	0.9	0.9
D-TAGATOSE	1.0	5.0	10.0	25.0	50.0

*Corn Syrup is evaporated to 85% solids, 15% moisture

*Glycerin and syrup may be blended and co-evaporated

TABLE 6
(WEIGHT PERCENT)

	EX. 34	EX. 35	EX. 36	EX. 37	EX. 38
SUGAR	50.0	46.0	41.0	25.0	0.0
GUM BASE	24.0	24.0	24.0	24.0	24.0
CORN SYRUP	24.0	24.0	24.0	24.6	24.6
GLYCERIN	0.0	0.0	0.0	0.4	0.4
FLAVOR	1.0	1.0	1.0	1.0	1.0
D-TAGATOSE	1.0	5.0	10.0	25.0	50.0

Examples 39-43 in Table 7 and Examples 44-53 in Tables 8 and 9 demonstrate the use of D-tagatose in low- and high-moisture gums that are sugar-free. Low-moisture gums have less than about 2% moisture, and high-moisture gums have greater than 2% moisture.

TABLE 7
(WEIGHT PERCENT)

	EX. 39	EX. 40	EX. 41	EX. 42	EX. 43
BASE	25.5	25.5	25.5	25.5	25.5
SORBITOL	50.0	46.0	41.0	26.0	0.0
MANNITOL	12.0	12.0	12.0	12.0	13.0
GLYCERIN	10.0	10.0	10.0	10.0	10.0
FLAVOR	1.5	1.5	1.5	1.5	1.5
D-TAGATOSE	1.0	5.0	10.0	25.0	50.0

TABLE 8
(WEIGHT PERCENT)

	EX. 44	EX. 45	EX. 46	EX. 47	EX. 48
BASE	25.5	25.5	25.5	25.5	25.5
SORBITOL	50.0	46.0	41.0	26.0	0.0
LIQUID SORBITOL*	10.0	10.0	10.0	10.0	11.0
MANNITOL	10.0	10.0	10.0	10.0	10.0
GLYCERIN	2.0	2.0	2.0	2.0	2.0
FLAVOR	1.5	1.5	1.5	1.5	1.5
D-TAGATOSE	1.0	5.0	10.0	25.0	50.0

*Sorbitol Liquid contains 70% sorbitol, 30% water

TABLE 9
(WEIGHT PERCENT)

	EX. 49	EX. 50	EX. 51	EX. 52	EX. 53
BASE	25.5	25.5	25.5	25.5	25.5
SORBITOL	50.0	46.0	41.0	26.0	0.0
HSH SYRUP*	10.0	10.0	10.0	10.0	10.0
MANNITOL	8.0	8.0	8.0	8.0	9.0
GLYCERIN**	4.0	4.0	4.0	4.0	4.0
FLAVOR	1.5	1.5	1.5	1.5	1.5
D-TAGATOSE	1.0	5.0	10.0	25.0	50.0

* Hydrogenated starch hydrolyzole syrup
** Glycerin and HSH syrup may be blended or co-evaporated

Table 10 shows sugar chewing formulations that can be made with various other types of sugars.

TABLE 10
(WEIGHT PERCENT)

	EX. 54	EX. 55	EX. 56	EX. 57	EX. 58	EX. 59
GUM BASE	19.2	19.2	19.2	19.2	19.2	19.2
SUCROSE	44.5	24.5	39.5	19.5	29.5	19.5
GLYCERIN	1.4	1.4	1.4	1.4	1.4	1.4
CORN SYRUP	14.0	14.0	14.0	14.0	14.0	14.0
DEXTROSE	5.0	5.0	-	-	10.0	5.0
LACTOSE	5.0	5.0	10.0	10.0	-	-
FRUCTOSE	5.0	5.0	10.0	10.0	10.0	5.0
INVERT SUGAR	-	-	-	-	10.0	10.0
MALTOSE	-	-	-	-	-	-
CORN SYRUP SOLIDS	-	-	-	-	-	-
PEPPERMINT FLAVOR	0.9	0.9	0.9	0.9	0.9	0.9
D-TAGATOSE	5.0	25.0	5.0	25.0	5.0	25.0

	EX. 60	EX. 61	EX. 62	EX. 63	EX. 64	EX. 65
GUM BASE	19.2	19.2	19.2	19.2	19.2	19.2
SUCROSE	29.5	19.5	29.5	19.5	37.5	22.5
GLYCERIN	1.4	1.4	1.4	1.4	1.4	1.4
CORN SYRUP	14.0	14.0	14.0	14.0	11.0	11.0
DEXTROSE	10.0	5.0	10.0	5.0	10.0	5.0
LACTOSE	-	-	-	-	-	-
FRUCTOSE	10.0	5.0	10.0	5.0	5.0	5.0
INVERT SUGAR	10.0	10.0	-	-	5.0	5.0
MALTOSE	-	-	10.0	10.0	-	-
CORN SYRUP SOLIDS	-	-	-	-	5.0	5.0
PEPPERMINT FLAVOR	0.9	0.9	0.9	0.9	0.9	0.9
D-TAGATOSE	5.0	25.0	5.0	25.0	5.0	25.0

Any of the sugars may be combined with D-tagatose and co-dried to form unique combinations such as:

EXAMPLE 66

Dextrose and D-tagatose can be dissolved in water in a 2:1 ratio dextrose:D-tagatose and co-dried or co-precipitated and used in the formulas in Table 10.

EXAMPLE 67

D-tagatose and sucrose can be dissolved in water in a 1:1 ratio and co-dried or co-precipitated and used in the formulas in Table 10.

EXAMPLE 68

D-tagatose, sucrose and dextrose can be dissolved in water in a 1:1:1 ratio and co-dried or co-precipitated and used in the formulas in Table 10.

EXAMPLE 69

D-tagatose, sucrose, dextrose and fructose can be dissolved in water at 25% of each ingredient and co-dried, and used in the formulas in Table 10.

EXAMPLE 70

D-tagatose, dextrose, fructose and lactose can be dissolved in water at 25% of each ingredient and co-dried, and used in the formulas in Table 10.

EXAMPLE 71

D-tagatose, dextrose, maltose and corn syrup solids can be dissolved in water at 25% of each ingredient and co-dried, and used in the formulas in Table 10.

EXAMPLE 72

D-tagatose, sucrose, dextrose, maltose and fructose can be dissolved in water at 20% of each ingredient and co-dried, and used in the formulas in Table 10.

Multiple combinations of D-tagatose with other sugars can be made in solution to form liquid concentrates that do not need to be co-dried, such as:

EXAMPLE 73

D-tagatose, corn syrup and glycerin can be dissolved in water at a ratio of 1:1:1, evaporated to a thick syrup and used in the formulas in Table 10.

EXAMPLE 74

D-tagatose, dextrose, fructose and invert syrup may be dissolved in water at 25% of each ingredient and evaporated to a thick syrup and used in the formulas in Table 10.

EXAMPLE 75

D-tagatose, dextrose, maltose and corn syrup solids may be dissolved in water at 25 % of each component and evaporated to a thick syrup and used in the formulas in Table 10.

EXAMPLE 76

Glycerin is added to Example 74 at a ratio of 4:1 syrup to glycerin and evaporated to a thick syrup, and used in the formulas in Table 10.

EXAMPLE 77

Glycerin is added to Example 75 at a ratio of 2:1 syrup to glycerin and evaporated to a thick syrup, and used in the formulas in Table 10.

Multiple combinations and combinations of two or three sugars can also be made by melting the sugars together at about 130°C, cooling, and grinding to form powder blends such as:

EXAMPLE 78

D-tagatose and dextrose are blended at a ratio of 1:1 and melted at 130°C. The blend is cooled, ground, and used in formulas in Table 10.

EXAMPLE 79

D-tagatose, dextrose, and fructose at a ratio of 1:1:1 are blended and melted at 130°C. The melted blend is cooled, ground, and used in formulas in Table 10.

Table 11 shows chewing gum formulations that are free of sugar. These formulations can use a wide variety of other non-sugar alditols.

TABLE 11
(WEIGHT PERCENT)

	EX. 80	EX. 81	EX. 82	EX. 83	EX. 84	EX. 85
GUM BASE	25.5	25.5	25.5	25.5	25.5	25.5
GLYCERIN	2.0	2.0	2.0	2.0	2.0	2.0
SORBITOL	44.0	34.0	34.0	29.0	28.0	-
MANNITOL	-	10.0	10.0	10.0	10.0	6.0
SORBITOL LIQUID	17.0	17.0	-	-	-	-
LYCASIN	-	-	17.0	12.0	8.0	10.0
MALTITOL	-	-	-	10.0	-	-
XYLITOL	-	-	-	-	15.0	15.0
LACTITOL	-	-	-	-	-	-
PALATINIT	-	-	-	-	-	-
FLAVOR	1.5	1.5	1.5	1.5	1.5	1.5
D-TAGATOSE	10.0	10.0	10.0	10.0	10.0	40.0

TABLE 11 (Cont'd)
(WEIGHT PERCENT)

	EX. 86	EX. 87	EX. 88	EX. 89	EX. 90	EX. 91
GUM BASE	25.5	25.5	25.5	25.5	25.5	25.5
GLYCERIN	8.0	8.0	8.0	2.0	3.0	2.0
SORBITOL	32.0	27.0	22.0	31.0	10.0	-
MANNITOL	8.0	8.0	8.0	-	-	-
SORBITOL LIQUID	5.0	-	-	-	-	-
LYCASIN	-	5.0	5.0	5.0	10.0	10.0
MALTITOL	-	5.0	-	-	-	-
XYLITOL	-	-	-	15.0	-	-
LACTITOL	10.0	10.0	10.0	-	-	-
PALATINIT	-	-	10.0	10.0	25.0	21.0
FLAVOR	1.5	1.5	1.5	1.5	1.5	1.5
D-TAGATOSE	10.0	10.0	10.0	10.0	25.0	40.0

Any of the alditols can be combined with D-tagatose and co-dried to form unique combinations, such as:

EXAMPLE 92

D-tagatose and sorbitol can be dissolved in water in a ratio of 2:1 sorbitol:D-tagatose and co-dried and used in formulas in Table 11.

EXAMPLE 93

D-tagatose, sorbitol and mannitol can be dissolved in water at a ratio of 1:1:1, co-dried, and used in appropriate formulas in Table 11.

EXAMPLE 94

D-tagatose, mannitol and xylitol can be dissolved in water at a ratio of 1:1:1, co-dried, and used in appropriate formulas in Table 11.

EXAMPLE 95

D-tagatose, sorbitol and lactitol can be dissolved in water at a ratio of 1:1:1, co-dried, and used in appropriate formulas in Table 11.

EXAMPLE 96

D-tagatose, palatinit and sorbitol can be dissolved in water at a ratio of 1:1:1, co-dried, and used in appropriate formulas in Table 11.

EXAMPLE 97

D-tagatose and palatinit can be dissolved in water at a ratio of 1:1, co-dried, and used in appropriate formulas in Table 11.

EXAMPLE 98

D-tagatose, sorbitol, maltitol and xylitol may be blended at 25% of each ingredient and dissolved in water, co-dried, and used in appropriate formulas in Table 11.

Multiple combinations of D-tagatose with the various alditols can be made in solution to form liquid concentrates that do not need to be co-dried, such as:

EXAMPLE 99

D-tagatose, sorbitol, maltitol and Lycasin brand hydrogenated starch hydrolysates may be dissolved in water at 25% of each ingredient, evaporated to a thick syrup and used in the appropriate formulas in Table 11.

EXAMPLE 100

D-tagatose, xylitol, sorbitol, and Lycasin can be dissolved in water at 25% of each ingredient, evaporated to a thick syrup, and used in the formulas in Table 11.

EXAMPLE 101

D-tagatose, sorbitol, lactitol and Lycasin can be dissolved in water at 25% of each ingredient,

evaporated to a thick syrup, and used in the formulas in Table 11.

EXAMPLE 102

D-tagatose, Lycasin and glycerin can be dissolved in water at a ratio of 1:1:1, evaporated to a thick syrup and used in the formulas in Table 11.

EXAMPLE 103

Glycerin is added to Example 99 at a ratio of 4:1 syrup to glycerin, evaporated to a thick syrup, and used in formulas in Table 11.

EXAMPLE 104

Glycerin is added to Example 100 at a ratio of 4:1 syrup to glycerin, evaporated to a thick syrup, and used in the formulas in Table 11.

EXAMPLE 105

Glycerin is added to Example 101 at a ratio of 4:1 syrup to glycerin, evaporated to a thick syrup, and used in formulas in Table 11.

Multiple combinations of one or two alditols with D-tagatose can be made by melting the D-tagatose and alditols together at about 130°C, cooling, and grinding to form powder blends, such as:

EXAMPLE 106

D-tagatose and sorbitol are blended at a 1:1 ratio and melted at 130°C. The blend is cooled, ground and used in formulas in Table 11.

EXAMPLE 107

D-tagatose, sorbitol and xylitol are blended at a 1:1:1 ratio and melted at 130°C. The blend is cooled, ground and used in formulas in Table 11.

High-intensity sweeteners such as aspartame, acesulfame K, or the salts of acesulfame, cyclamate and its salts, saccharin and its salts, alitame, sucralose, thaumatin, monellin, dihydrochalcone, stevioside,

glycyrrhizin, and combinations thereof may be used in any of the Examples listed in Tables 4, 5, 6, 7, 8 9, 10 and 11. Since D-tagatose has slightly less sweetness than some of the other sugars used in sugar gum, and some of the alditols in sugar-free gum, a high-intensity sweetener may be need to obtain the proper level of sweetness.

High-intensity sweeteners may also be modified to control their release in chewing gum formulations containing D-tagatose. This can be controlled by various methods of encapsulation, agglomeration, absorption, or a combination of methods to obtain either a fast or slow release of the sweetener. Sweetener combinations, some of which may be synergistic, may also be included in the gum formulations containing D-tagatose.

The following examples show the use of high-intensity sweeteners in chewing gum formulations with D-tagatose.

EXAMPLE 108

Aspartame at a level of 0.2% may be added to any of the formulas in Tables 4 through 11 by replacing 0.2% of the D-tagatose.

EXAMPLE 109

Alitame at a level of 0.03% may be added to any of the formulas in Tables 4 through 11 by replacing 0.03% of the D-tagatose.

EXAMPLE 110

Sucralose at a level of 0.07% may be added to any of the formulas in Tables 4 through 11 by replacing 0.07% of the D-tagatose.

EXAMPLE 111

Thaumatin at a level of 0.02% may be added to any of the formulas in Tables 4 through 11 by replacing 0.02% of the D-tagatose.

EXAMPLE 112

Glycyrrhizin at a level of 0.4% may be added to any of the formulas in Tables 4 through 11 by replacing 0.4% of the D-tagatose.

High-intensity sweeteners may also be combined with other high-intensity sweeteners, with or without encapsulation, agglomeration or absorption, and used in chewing gum. Examples are:

EXAMPLE 113

Aspartame and acesulfame K at a 1:1 ratio may be added to any of the formulas in Tables 4 through 11 at a level of 0.15% by replacing 0.15% of the D-tagatose.

EXAMPLE 114

Aspartame and alitame at a ratio of 9:1 aspartame: alitame may be added to any of the formulas in Tables 4 through 11 at a level of 0.1% by replacing 0.1% of the D-tagatose.

EXAMPLE 115

Aspartame and thaumatin at a ratio of 9:1 aspartame:thaumatin can be added to any of the formulas in Tables 4 through 11 at a level of 0.1% by replacing 0.1% of the D-tagatose.

EXAMPLE 116

Sucralose and alitame in a ratio of 3:1 sucralose: alitame can be added to any of the formulas in Tables 4 through 11 at a level of 0.5% by replacing 0.5% of the D-tagatose.

EXAMPLE 117

Alitame and glycyrrhizin in a ratio of 1:12 alitame:glycyrrhizin can be added to any of the formulas in Tables 4 through 11 at a level of 0.1% by replacing 0.1% of the D-tagatose.

EXAMPLE 118

Aspartame and glycyrrhizin in a ratio of 1:14 aspartame:glycyrrhizin can be added to any of the formulas in Tables 4 through 11 at a level of 0.3% by replacing 0.3% of the D-tagatose.

As discussed above, D-tagatose ingredients that are available are crystalline D-tagatose and D-tagatose syrup. These materials may be used exclusively in a variety of chewing gum formulations, as in Tables 12 and 13.

TABLE 12
(WEIGHT PERCENT)

	EX. 119	EX. 120	EX. 121	EX. 122	EX. 123
GUM BASE	19.2	30.5	35.5	30.5	30.0
GLYCERIN	2.0	2.0	7.0	7.0	2.0
D-TAGATOSE CRYSTALLINE*	67.8	56.0	51.0	46.0	45.5
D-TAGATOSE SYRUP*	10.0	10.0	5.0	15.0	20.0
FLAVOR	1.0	1.5	1.5	1.5	2.5

*D-tagatose crystalline and D-tagatose syrup may also be preblended and coevaporated to reduce moisture.

TABLE 13
(WEIGHT PERCENT)

	EX. 124	EX. 125	EX. 126	EX. 127	EX. 128	EX. 129
GUM BASE	25.5	25.5	25.5	25.5	50.0	70.0
GLYCERIN	2.0	2.0	7.0	15.0	2.0	1.0
D-TAGATOSE CRYSTALLINE*	51.0	61.0	51.0	43.0	45.5	24.0
D-TAGATOSE SYRUP*	20.0	10.0	15.0	15.0	---	2.0
FLAVOR	1.5	1.5	1.5	1.5	2.5	3.0

*D-tagatose crystalline and D-tagatose syrup may also be preblended and coevaporated to reduce moisture.

The formulation in Table 12 and 13 do not contain other sugars or alditols. These formulations will give unique texture and flavor attributes. These formulations may also contain high-intensity, artificial sweeteners, from about 0.02% to about 0.1% for sweeteners like alitame, thaumatin, and dihydrochalcone, and from about 0.1% to about 0.3% for sweeteners like aspartame, sucralose, acesulfame, and saccharin. The formulations in Tables 12 and 13 without the other types of sugars and alditols will also have good non-cariogenic properties.

It should be appreciated that the compositions and methods of the present invention are capable of being incorporated in the form of a variety of embodiments, only a few of which have been illustrated and described above. The invention may be embodied in other forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive, and the scope of the invention, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

WE CLAIM:

1. A chewing gum composition comprising:
a) about 5% to about 95% gum base;
b) about 0.1% to about 10% of a flavoring agent, and
c) about 5% to about 95% D-tagatose, the D-tagatose comprising the only bulking and sweetening agent in the gum.

2. The chewing gum composition of claim 1 wherein the D-tagatose is in the form selected from the group consisting of crystalline D-tagatose, D-tagatose syrup and mixtures thereof.

3. A chewing gum product including D-tagatose wherein the D-tagatose is used as a dusting agent on the surface of the gum.

4. A coated chewing gum product comprising a gum pellet coated with a hard coating, the hard coating comprising D-tagatose.

5. A method of making chewing gum comprising the steps of:
a) coevaporating an aqueous solution comprising D-tagatose and a plasticizing agent to form a syrup, and
b) mixing the syrup with gum base, bulking agents and flavoring agents to produce a gum composition.

6. A chewing gum composition sweetened at least in part by aspartame, the gum composition containing an effective amount of D-tagatose to

stabilize the aspartame against degradation into non-sweetening derivatives.

7. A method of making chewing gum comprising the steps of:

a) codrying a solution containing D-tagatose and another sweetener selected from the group consisting of sugar sweeteners, alditol sweeteners and high-potency sweeteners, and

b) mixing the codried D-tagatose/ sweetener with gum base and flavoring agents to produce a gum composition.

8. A liquid-filled chewing gum product wherein the liquid fill comprises D-tagatose.

9. A chewing gum composition comprising:

a) about 5% to about 95% gum base;

b) about 0.1% to about 10% of a flavoring agent; and

c) about 5% to about 95% bulking and sweetening agents, the bulking and sweetening agents comprising D-tagatose and the gum having less than 2% moisture.

10. A chewing gum composition comprising:

a) about 5% to about 95% gum base;

b) about 0.1% to about 10% of a flavoring agent; and

c) about 5% to about 95% bulking and sweetening agents, the bulking and sweetening agents comprising D-tagatose, wherein the D-tagatose comprises about 5% to about 50% of the gum composition.